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[redacted]

November 30, 1981

[redacted] "Utilities Alternatives"

Dear Sir:

Enclosed are two copies of the Plan Approval package. The project will proceed as indicated therein until and unless you direct otherwise.

Point-of-departure concepts for power distribution systems have been developed for Building Models I and II, under the conventional assumption of an all-electric Environmental Control System (ECS). Their single-line diagrams have been drawn and their availability is being calculated. As you may suppose, from the significant similarity of estimated load requirements for the two models (see paragraph 1.1.5-Total Stations Service Requirements), the concepts differ only in small detail. This, along with the generally non-specific nature of the facility to be serviced, leads me to recommend that you consider redirecting the project to: (1) fully develop a range of utility concepts for only one model - say, Model I; (2) assume that patterns and relationships observed will apply to either model; (3) produce a model-to-model comparison for only one availability level; and (4) use the time and effort thus saved to further explore a greater number of non-conventional utility approaches that we may believe to have potential.

In light of the recommendation above, I propose to emphasize concept developments for only Model I in the time before the Status Review meeting suggested in early January, with discussion of that redirection to be a significant agenda item at that time.

I welcome any discussion you may wish to have, and hope for a response within, say, two weeks.

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UTILITIES ALTERNATIVES

PROJECT PLAN APPROVAL PACKAGE

- Project Activity Flow Chart (1 pg)
- Project Planning Sheet/Schedule (1 pg)
- Ground Rules & Assumptions (3 pgs)
- Requirements (7 pgs)
- Outline (tentative) of Final Report (2 pgs)

Attachment: Memo on Local Power Outages

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16 November 1981

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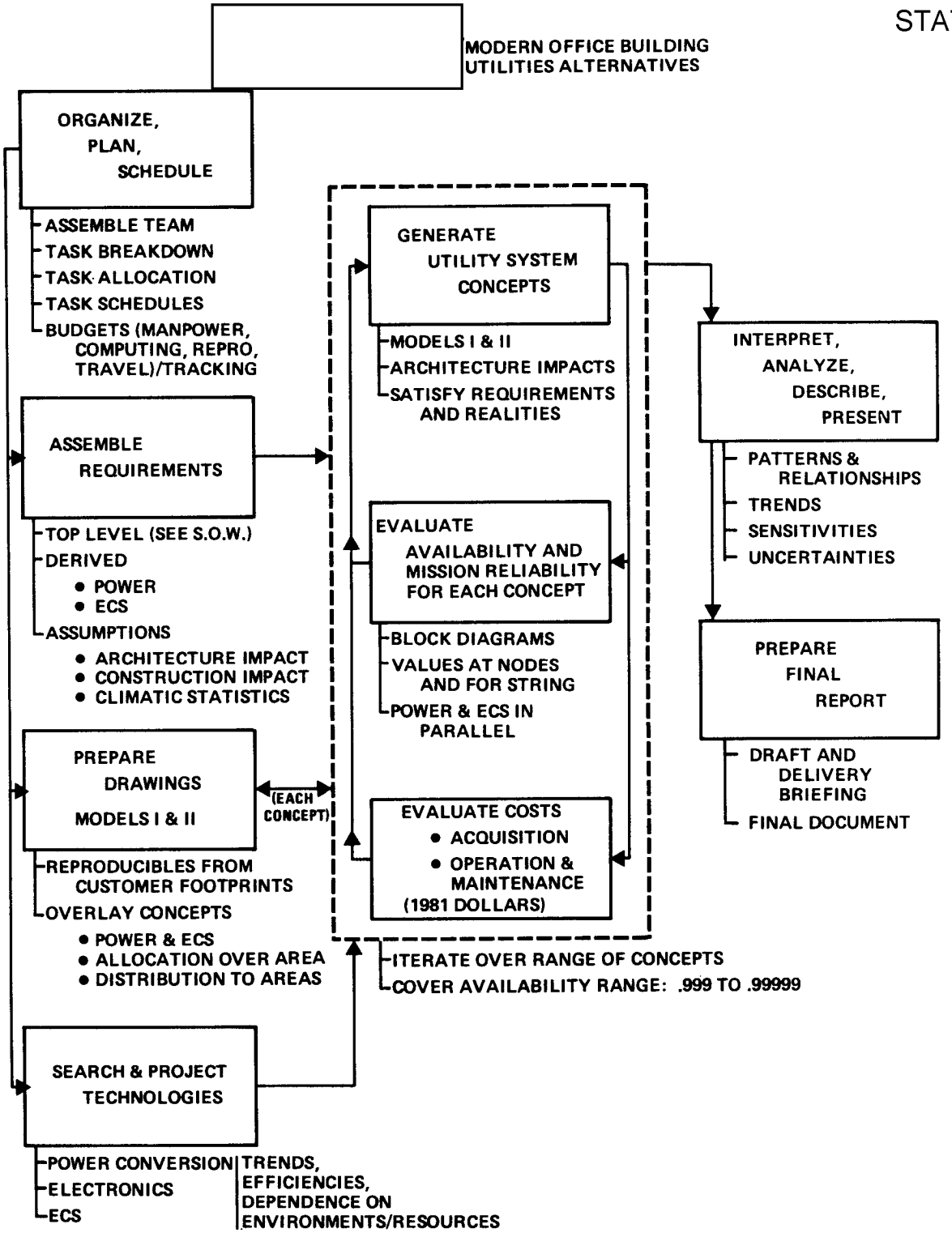

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- Electric Power Items

  - Prime power to be treated as both purchased and generated.
  - Oil and coal to be considered as fuels for prime power generation. Oil only will fuel emergency power generators.
  - Solid-state UPS and dedicated continuous engine-generators will both be considered for supplying critical power.
  - A proper grounding system will be assumed to exist, and will not be treated in this study.
  - All power factors assumed to be 0.9, lagging.
  - All distribution losses assumed to be 3%.
  - Within the floor areas dedicated to major electronic centers, the main frame computer systems are assumed to require 25 watts per square foot, and lighting (area and task) to require 3 watts per square foot. Loads required by environmental control system (ECS) equipment are not included in the above. These loads are fully on 24 hours per day.
  - Within the remaining floor area of the facility, designated as general office area, loads will be assumed to be 3 watts per square foot for lighting and 4 watts per square foot for miscellaneous loads, not including ECS loads. The lighting duty is assumed to be fully on 12 hours per day. The miscellaneous load will be on for 12 hours and off for 12 hours per day.
  - Metering will not be treated in this study.
  - Critical technical loads will be main-frame computers only (including some task lighting).
  - Essential technical loads will consist of:
    - 100% of main-frame computer air conditioning;
    - 100% of UPS air conditioning, when applicable;
    - 50% of general office area loads (lighting and miscellaneous);
    - 50% of general office area ECS loads.
  - Non-technical loads will consist of:
    - The other 50% of general affixed area loads;
    - the other 50% of general office area ECS loads.

- ECS Items

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  - Building envelope heat losses and gains will be calculated on the basis of plan dimensions scaled from the footprint sketches dated 19 Oct 81 and on floor-to-floor heights assumed above. The major axis of the models will be assumed to be in a North-South orientation, with the

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glazing fractions assumed above to be uniform for all walls. Wall thermal resistances will be assumed to conform to the values taken from ASHRAE Standard 90-A,B,C (see Requirements, Section 2.2), and maximum heating/cooling loads will be based on the 97-1/2/2-1/2% ambient conditions described in Requirements, Section 2.1.

- General Items

  - Reliability/availability of critical power will be calculated to an end-point that would be the interface with computer hardware. Reliability/availability of essential power will be concurrently calculated only to 480 VAC distribution panels on each floor, since the configuration from there to loads is quite load dependent (eg: a mini-computer would typically be connected through a regulator/power conditioner, such as from Sola, Inc.).

  - Costs will be based on critical power distributed to only the lower two floors of each model, while upper floors will have three essential power panels and two normal power panels each. Costs will be shown for both initial and final configuration of each building model, expressed in 1981 dollars for both capital/acquisition and for operation/maintenance/replacement. Incremental acquisition of hardware (diesel-generators, transformers, etc.) for final configurations is at the discretion of the customer, and will not be treated.

    Power availability from the commercial utility will be assumed to conform to that shown in the attached memo: "Utility Power Outages",
STAT [redacted] 17 November 1981, in which two sets of parallel feeders are assumed to be joined together prior to the station input transformer. With the thunderstorm threat thus reduced, the availability will be taken as 0.99906.

  - A computerized, high-reliability Energy Management Control System (EMCS) will be assumed to exist, with interfaces to fire protection systems. The EMCS will not be studied, traded nor costed.

  - Other utilities, such as water, sewage, etc., will not be studied, traded nor costed except as a possible delta-cost for special uses to enhance mission reliability (eg: large water storage for thermal management would be costed).

  - No earthquake threat is assumed to exist. (UPS battery racks for earthquake-prone zones are several times more expensive).

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1.3 POWER QUALITY REQUIREMENTS

The Computer Business Equipment Manufacturers Association (CBEMA) is in the process of establishing standards of computer power requirements. This study will assume their standards will be established, as follows.

Typical limits:

- Frequency: Nominal ± 1% for most computers:

  Can be as critical as ± 0.3% for some equipment (not in this study)

  Maximum rate of frequency change: 0.3 to 1.5 Hz/second

- Voltage
  (reference, note: current IBM main frame limits are +10%, -8%)

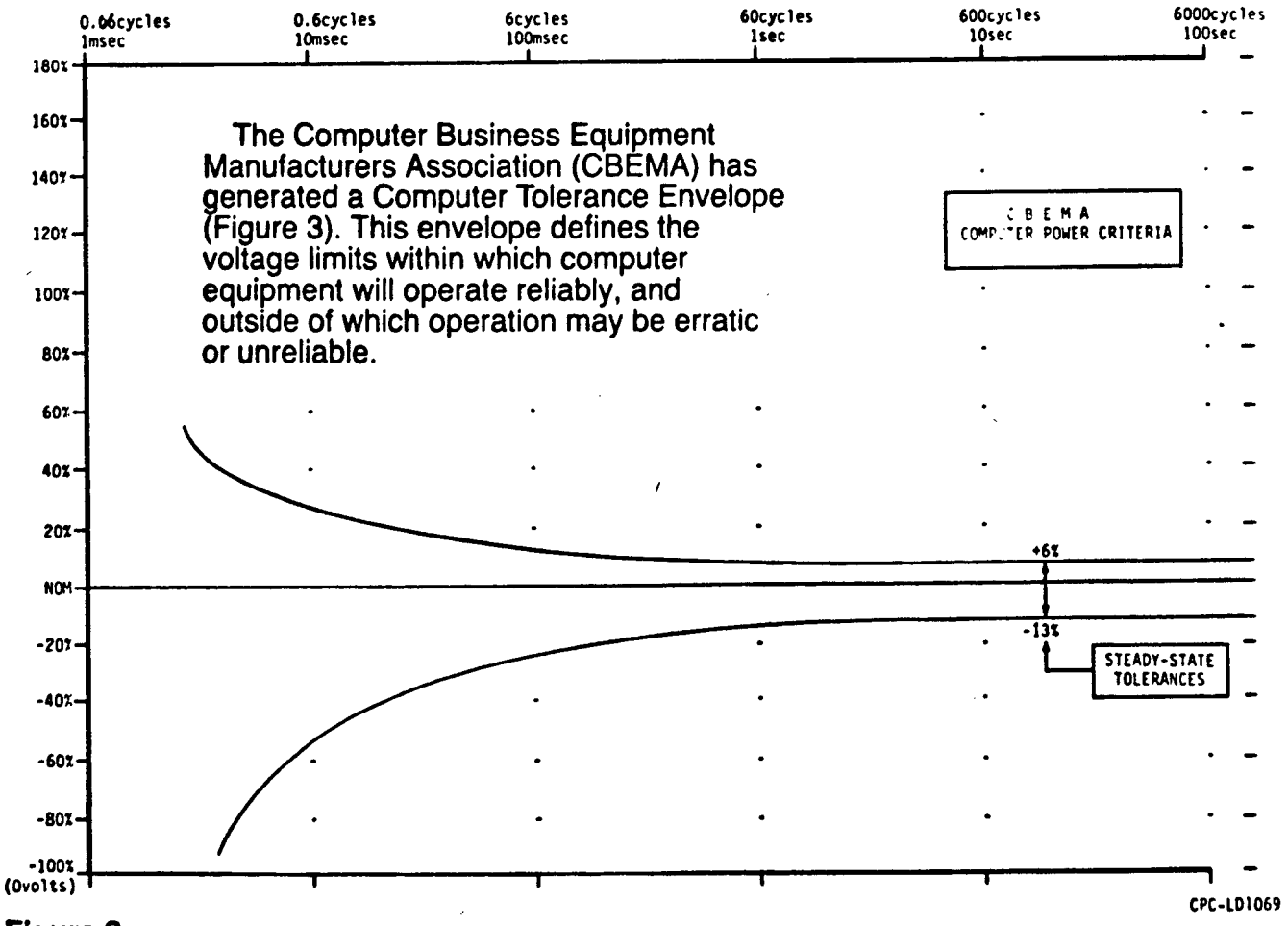

Figure 3.
CBEMA Computer Power Criteria.

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- Transients: 20% Dips or Surges < 30 milliseconds
- Continuity: loss of voltage < 15 milliseconds
- Harmonics: 10-15% total
- Impulse: Varies over a large range (200 to 1500 volts)

2.0 ENVIRONMENTAL CONTROL REQUIREMENTS

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2.1

2.2 Interior Environmental Control Requirements

In general, the ECS shall conform to the following ASHRAE Standards:

ANSI/ASHRAE/IES 90A-1980
ASHRAE/IES 90B-1975
ASHRAE 90C-1977

entitled: "Energy Conservation in New Building Design."

2.2.1 Computer Area ECS Requirements

Maximum operating temperature range: 65°-80°F
Design operating temperature range: 70°-74°F
Maximum operating relative humidity range: 40-65%
Design operating relative humidity range: 40-50%
Maximum rate of temperature change: 15°F per hour
Quality of filtration (NBS discoloration efficiency, Atmospheric dust):

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Dry Media Filters - 45% (min. 20%)

Electrostatic Filters - 90% (min. 85%)

Ventilation: 5% outdoor air shall be provided to provide slight over-pressurization of the computer areas and to satisfy fresh air needs of the occupants of the computer areas.

2.2.2 General Office Area ECS Requirements

New energy shall not be used to raise room temperatures above 72°F or below 78°F, nor to raise relative humidity above 30% or below 60%.

Design shall be based on 72°F interior temperature in conjunction with 97-1/2% outside conditions and on 78°F interior temperature in conjunction with 2-1/2% outside conditions. Ventilation requirements shall be 15 CFM per occupant, minimum (15 to 25 CFM recommended).

2.2.3 ECS Availability

The ECS shall be designed to ensure that the environments within the maximum operating ranges described in 2.2.1 for computer areas will be available with the same probability as the computer system which it supports.

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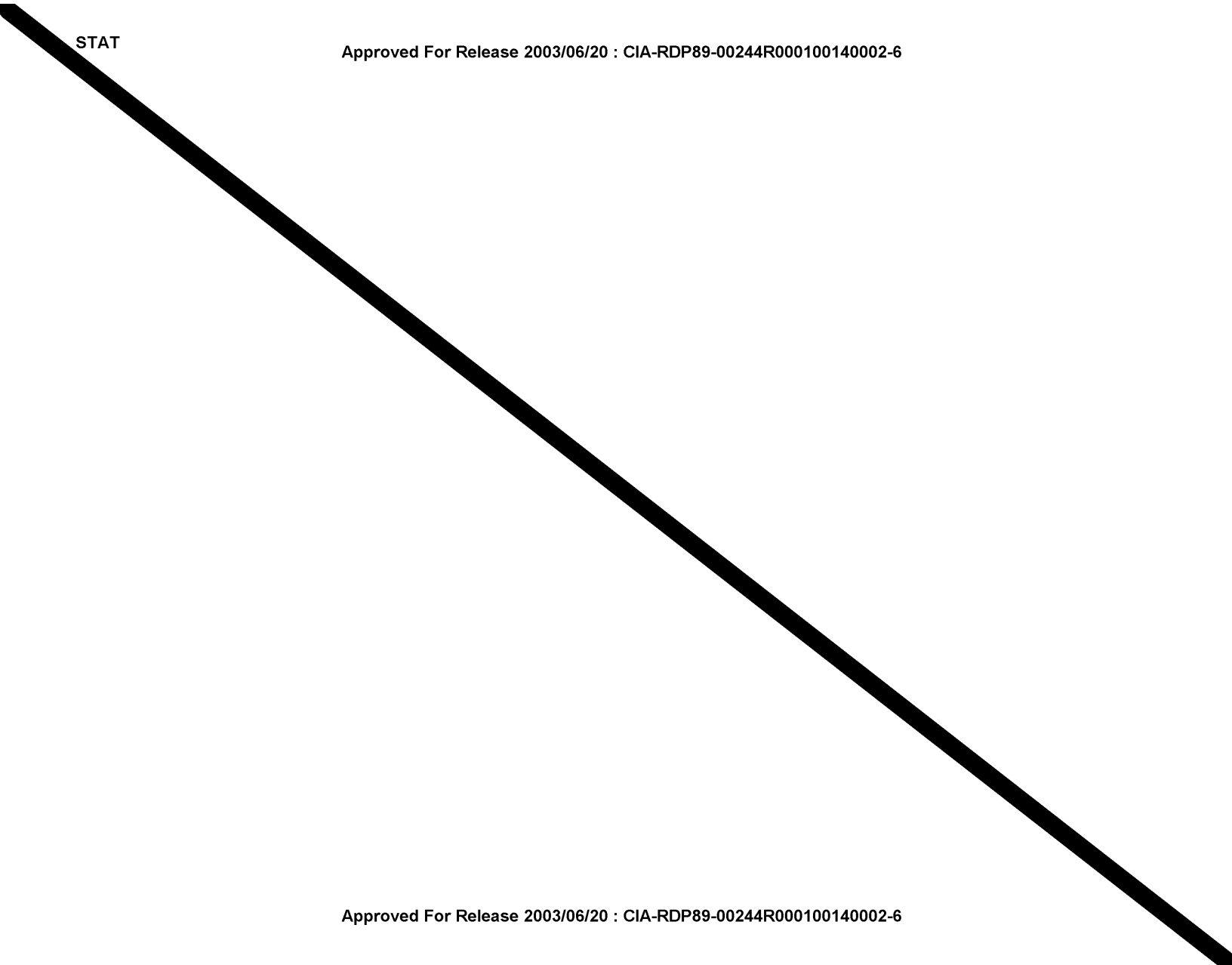

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OUTLINE OF FINAL REPORT, [redacted]

UTILITY ALTERNATIVES FOR MODERN OFFICE BUILDINGS

1. Introduction
2. Executive Summary
3. Requirements: Analysis and Interpretation
   - 3.1 Groundrules and Assumptions
   - 3.2 Electric Power Subsystem
   - 3.3 Thermal Subsystems
4. Energy Subsystem Options
   - 4.1 Electric Power Subsystem
     - 4.1.1 Commercial, Public Utility Source
     - 4.1.2 On-Site Generation, Primary and Emergency
       - 4.1.2.1 Diesel Engine-Generators
       - 4.1.2.2 Gas Turbine-Generators
       - 4.1.2.3 Steam Turbine Generators
     - 4.1.3 Critical Load Protection
   - 4.2 Thermal Subsystems
     - 4.2.1 Environmental Conditioning
       - 4.2.1.1 Accommodating Winter Heating Loads
       - 4.2.1.2 Satisfying Cooling Loads
     - 4.2.2 Heat Sinks
5. Optimal Building Utility Scenarios
   - 5.1 Building Model I
     - 5.1.1 Description, Availability and Costs: Case I-1 (N-scenarios ($N \geq 3$) to cover availability range from 0.999 to 0.99999)
     - 5.1.N

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